BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIGs. 1A,B,C illustrate three different load situations in an elbow crutch equipped with a the novel knee support in perspective views.
FIG. 1A shows the effect of the moment which develops when a downward force (body weight) is applied at the support. As this force is countered by an offset reaction force (counter force at tip of crutch), a moment is generated which pushes the crutch against the user's hip.
FIG. 1B shows the unstable situation in an elbow crutch without rest element. The top of the crutch tends to wobble back and forth as indicated.
FIG. 1C shows how the rest element **40** of this invention stabilizes the crutch when said rest is pushed against the thigh. When the knee is held relaxed, the weight of the foot creates a moment which pushes the rest against the thigh as indicated.

~~FIG.2~~ FIG. 2A shows the knee support used in a Shepherd's crutch (axillary crutch) ~~and, together with the rest element, in an elbow crutch~~ in a perspective view.
FIG. 2B shows the knee support together with the rest element **40** in an elbow crutch in a perspective view.

FIG. 3 shows a perspective and an explosion view of an examplary knee support element. The four main components are identified by numbers **30 – 33**.

~~FIG. 4~~ FIG. 4A shows a top ~~and perspective~~ view of an examplary rest element **40**.
FIG. 4B shows a perspective view of an examplary rest element **40**.

DETAILED DESCRIPTION OF THE INVENTION

The present invention consists of two parts: a detachable knee or lower leg support which can be clamped to the tubular post of a conventional forearm, elbow or axillary crutch and a rest element which is not required in axillary crutches, but should be used together with a support in all forearm or elbow crutches.

Such a rest element makes walking safer and standing easier because it provides a comparatively stable support point similar to the armpit in axillary crutches. Otherwise, the user is confined to using the grip and forearm rest of the crutch, which makes a fairly unstable support point~~; the upper crutch is pushed against the body when the knee is pushed onto its support (FIG.1A), but it can still move forward and backward and has to be held parallel to the long axis of the thigh by an active balancing effort (FIG 1B)~~.

FIG. 1A illustrates the forces and moments to be considered when the user puts his right knee onto the cushion of the support with a force F. This force will be caused by a part of the user's body weight force. The direction of **F** is shown by the bold arrow and its line of action is indicated by the thin line extending from the arrow's tip.
In static equilibrium, a counter force **−F** is generated at the tip of the crutch. As the lines of action of both forces **F**,**−F** do not coincide, a turning moment **M** is generated. The direction of **M** is shown by the curved bold arrow and the axis of rotation is indicated by a thin line.
M exerts a force on all crutch components and will push the hand grip of the crutch against the user's thigh with a force **R** depending on the distance **d** between the crutch tip and the hand grip.

The push of **R** stabilizes the crutch in a vertical plane defined by the directions of **R** and **d**. However, the crutch can still move forward and backward and has to be held parallel to the long axis of the thigh by an active balancing effort as shown in FIG 1B. The bold arrows **s**,**−s** indicate the direction in which the crutch is still free to move. The various components of the knee or lower leg support are numbered **30**–**33**.

With a rest element **40**, a simple push of the rest against the thigh instead of a balancing action is all that is necessary to maintain control of the crutch (FIG.1C). Therefore, loss of control is less likely to occur when the user's attention is distracted from the pure walking action.
In the stationary standing position, the rest element **40** is automatically pushed against the thigh when some of the body weight is put onto the leg support. When the knee is held relaxed, the weight **W** of the foot creates a moment $\mathbf{M}_W$ which pushes the rest **40** against the thigh with a force $\mathbf{R}_W$ as indicated.

The rest element can be designed in very different ways. It may push against the thigh from the front or the back. The preferred embodiment 40 uses a push from the front and consists of a curved tube attached to the crutch by means of a clamp ~~(FIG. 4)~~(FIGs. 4A,B). The element can be adjusted to fit either leg by removing the clamp, rotating said tube around its long axis and reattaching the clamp again.
As mentioned above, the rest element is not required in axillary crutches. Most previous inventions related to knee or lower leg supports in axillary crutches, so that the need for an additional means of stability in shorter crutches was overlooked until now.

Together with the rest element described above, the knee support of the present invention provides a system which can be used in a large variety of crutches.

The knee support element consists of several typical components. A preferred embodiment is shown in FIG. 3; the components are:

a) A padded cushion **30** – this cushion may have several shapes. It is fixed to the remaining parts of the support by velcro or other suitable means. The cushion may be moulded, custom made, rounded or shaped and padded in any other suitable design.

b) A cushion bearing plate **31** – this plate may be perforated to reduce weight and it may be inclined or curved to allow the use of knee flexion angles smaller than 90°.

c) A plate holder **32** – this holder is aligned parallel to the long axis of the crutch. It is the main connecting element between the clamp component or components and the plate **31**. The holder is usually equipped with a diagonal support bar running to the lateral part of the plate from below, but this is not an essential feature. If components **31** and **32** are made of sufficiently stiff and strong material, the holder can assume any other suitable shape.

d) One or several clamp elements **33**. These clamps are an essential feature of the present invention. They are connected to or are part of the plate holder **32** and allow a firm but detachable fixation to a tubular crutch post. The point of fixation at the crutch can be chosen as desired and changed at will, allowing an easy adjustment to individual limb lengths.